

S P E C I F I C A T I O N

BE IT KNOWN THAT WE, HIROSHI UEDA and HITOSHI MORISHITA all residing at c/o ADVANCED DISPLAY INC., 997, Miyoshi, Nishigoshi-machi, Kikuchi-gun, KUMANOTO 861-1198, JAPAN, subjects of Japan, have invented certain new and useful improvements in

LIQUID CRYSTAL DISPLAY

of which the following is a specification:-

LIQUID CRYSTAL DISPLAY

BACKGROUND OF THE INVENTION

The present invention relates to a device subject to pushing a thermocompression bonding tool against a lead of an electronic part to be connected to a printed circuit board.

5           Examples of a technique for mounting a driving circuit through thermocompression bonding include a technique for mounting an IC module of a liquid crystal display. The liquid crystal display is generally obtained by connecting a driving circuit to a TFT liquid crystal module interposing liquid crystal material between two glass substrates and superposing them on an illuminating device. In general, the driving circuit of the TFT (thin film transistor) liquid crystal module is constituted by a tape-shaped film carrier package (TCP) provided with an LSI for driving TFTs and a printed circuit board (PCB) for sending power and image signals to the TFT module. Fig. 3 is a diagram showing the structure of a driving circuit section of a conventional TFT liquid crystal module. The reference numeral 1 denotes a TFT substrate on which a plurality of source electrodes and gate electrodes are formed, the reference numeral 2 denotes a color filter, the reference numerals 3 and 4 denote ACF (anisotropic conductive films) in which conductive particles are distributed into adhesive material, the reference numeral 5 denotes a driving LSI, the reference numeral 6 denotes TCPs provided with the driving LSI and having input terminals and output terminals, and the reference numeral 7 denotes the printed circuit boards. The ACF 3 is bonded to a terminal section of the TFT substrate 1 where the  
10           TCPs 6 are aligned and temporarily compression bonded one by one.  
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shape is more remarkable in a closer portion to both ends of the terminal arrangement. In the invention described in the Japanese Unexamined Patent Publication No. 260421/1998, the electrodes are formed like a rectilinear fan. However, the shape of the TCP lead is different from that of the glass substrate electrode after the compression bonding. Therefore, this invention is insufficient for the countermeasure to be taken for the terminal shift.

It is an object of the present invention to provide liquid crystal display and method of manufacturing the same in which a positional shift of a glass substrate electrode and a TCP lead can be prevented from being generated due to deformation during compression bonding.

#### SUMMARY OF THE INVENTION

A first aspect of the present invention is directed to a liquid crystal display having a plurality of electrode terminals arranged on one of ends of a TFT glass substrate and having a lead terminal of a tape carrier package aligned on the electrode terminals and connected through an anisotropic conductive film, wherein the electrode terminal of the glass substrate is formed to be bent obliquely in at least one place in the vicinity of an end face.

A second aspect of the present invention is directed to a liquid crystal display having a plurality of electrode terminals arranged on one of ends of a TFT glass substrate and having a lead terminal of a tape carrier package aligned on the electrode terminals and connected through an anisotropic conductive film, wherein the lead terminal of the tape carrier package is formed to be bent obliquely in at least one place

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in the vicinity of an end face of a glass substrate electrode.

### BRIEF DESCRIPTION OF THE DRAWINGS

5 Figs. 1(a) and 1(b) are diagrams showing the structure of a part in which a printed circuit board is to be connected according to an embodiment of the present invention;

10 Figs. 2(a) and 2(b) are diagrams showing the structure of a part in which an electrode terminal of a TFT is provided straight and a part of a TCP lead is formed obliquely according to another embodiment of the present invention; and

Fig. 3 is a diagram showing the structure of a driving circuit section of a conventional TFT liquid crystal module.

### DETAILED DESCRIPTION

15 An embodiment of a method of connecting a printed circuit board and a device formed thereby according to the present invention will be described below with reference to the accompanying drawings. Figs. 1 (a), 1(b), 2(a) and 2(b) are plan views illustrating an example of a liquid crystal module according to the embodiment of the present  
20 invention. As shown in Fig. 3, the liquid crystal module is constituted by a TFT substrate 1 provided with a plurality of source electrodes and gate electrodes, and a TCP 6 having a driving LSI 5 mounted thereon. An electrode arranged on the TFT substrate 1 and a lead of the TCP 6 are connected to each other through an anisotropic conductive film 3.  
25 Thus, conduction is obtained. Figs. 1(a), 1(b), 2(a) and 2(b) show two embodiments of the present invention. Fig. 1(a) and Fig. 2(a) illustrate a TFT electrode terminals 8 which are aligned in a comb teeth manner

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along an end face of the TFT substrate 1 and TCP lead 9 which have not been connected, and Fig. 1(b) and Fig. 2(b) illustrate the TFT electrode terminal 8 and the TCP lead 9 which have been connected. In an example of Figs. 1(a) and 1(b), a part of the electrode terminal 8 is obliquely formed on the TFT substrate 1 and the TCP lead 9 is formed straight. As shown in Fig. 1(a), the electrode terminal 8 formed on the TFT substrate 1 is divided into a straight region 8a and an oblique region 8b. For example, if the TFT electrode terminal 8 has a length of 1.1 mm, the 8a portion is formed to have a length of approximately 0.6 to 0.7 mm and the 8b portion is formed to have a length of approximately 0.4 to 0.5 mm. The 8b portion is appropriately inclined with respect to the 8a portion at an angle of 1.1 to 1.4 degrees on both ends of the TCP 6 having a width of 25 mm. A gradient of the 8b portion is 0 degree in a central part of the TCP 6 and is set to be increased in proportion to a distance from a center of the TCP 6. When the electrode terminal 8 of the TFT substrate and the TCP lead 9 which are formed with such a structure are connected through the anisotropic conductive film 3 by thermocompression bonding, the TCP lead 9 is bent in the middle through thermal expansion in the same manner as the electrode terminal 8 of the TFT substrate as shown in Fig. 1B and is superposed on the TFT substrate electrode 8 with high precision. In an example of Fig. 2, a part of the TCP lead 9 is formed obliquely and the electrode terminal 8 is formed straight on the TFT substrate. The TCP lead 9 is divided into a straight region 9a and an oblique region 9b. A ratio of lengths of the regions 9a and 9b and angles are the same as those in the example of Figs. 1(a) and 1(b). When the electrode terminal 8 of the TFT substrate and the TCP lead 9 which are formed with such a structure are

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connected through the thermocompression bonding through the anisotropic conductive film 3, the TCP lead 9 is formed straight through the thermal expansion in the same manner as the electrode terminal 8 of the TFT substrate and is superposed on the electrode terminal 8 with high precision as shown in Fig. 2(b).

The present invention is effective for connecting an electrode formed on a flexible film having a large coefficient of thermal expansion to another electrode through thermocompression bonding as in the connection of a printed circuit board of a liquid crystal display, for example.

As described above, according to the present invention, the oblique region is previously formed on the TFT substrate electrode 8 or a part of the TCP lead 9. Consequently, the TFT substrate electrode 8 and the TCP lead 9 can have the same shapes through the thermal expansion of the TCP 6 during the thermocompression bonding so that a mutual positional shift can be almost eliminated. As a result, the generation of a short-circuit can be prevented between adjacent electrodes and a contact area of a terminal to be connected can be maintained. Therefore, it is also possible to prevent defective open of the connection so that the quality of a module can be enhanced. These effects are more remarkable in case with a smaller pitch of the electrode to be connected.

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